Litton Systems, Inc
109
SCS Engineers
6-25-91

PLAN OF ACTION
LITTON ADVANCED CIRCUITRY DIVISION
SPRINGFIELD, MISSOURI

Prepared for:

Litton Industries, Inc.
490 L'Enfant Plaza East, SW
Suite 8206
Washington, DC 20024-2179

Prepared by:

SCS Engineers
11260 Roger Bacon Drive
Reston, VA 22090
(703) 471-6150

30289704

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PLAN OF ACTION

INTRODUCTION

Litton's Advanced Circuitry Division (ACD) in Springfield, Missouri manufactures printed circuit boards. The ACD facility has been in operation since 1963. Historical wastewater management units used at the facility are shown on Figure 1. Wastewater was discharged to percolation ponds located north of the parking lot until 1976, when the former "A" and "B" lagoons were placed into operation. The "A" and "B" lagoons were closed in 1982 when the ACD facility was connected to the City of Springfield sewer system. Following analysis of soil samples, final closure of the lagoons was approved by both the U.S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR).

Other on-site disposal features used in the past were two acid pits and one sludge pit. Additionally, surface discharge to a former lagoon on the west side of Airport Road took place until the late 1970's or early 1980's.

In connection with a prospective sale of the ACD facility, a preliminary environmental assessment of the ACD facility was undertaken by SCS Engineers. Seven shallow monitoring wells were installed and sampled as a part of the preliminary environmental assessment; an existing (but unused) production well

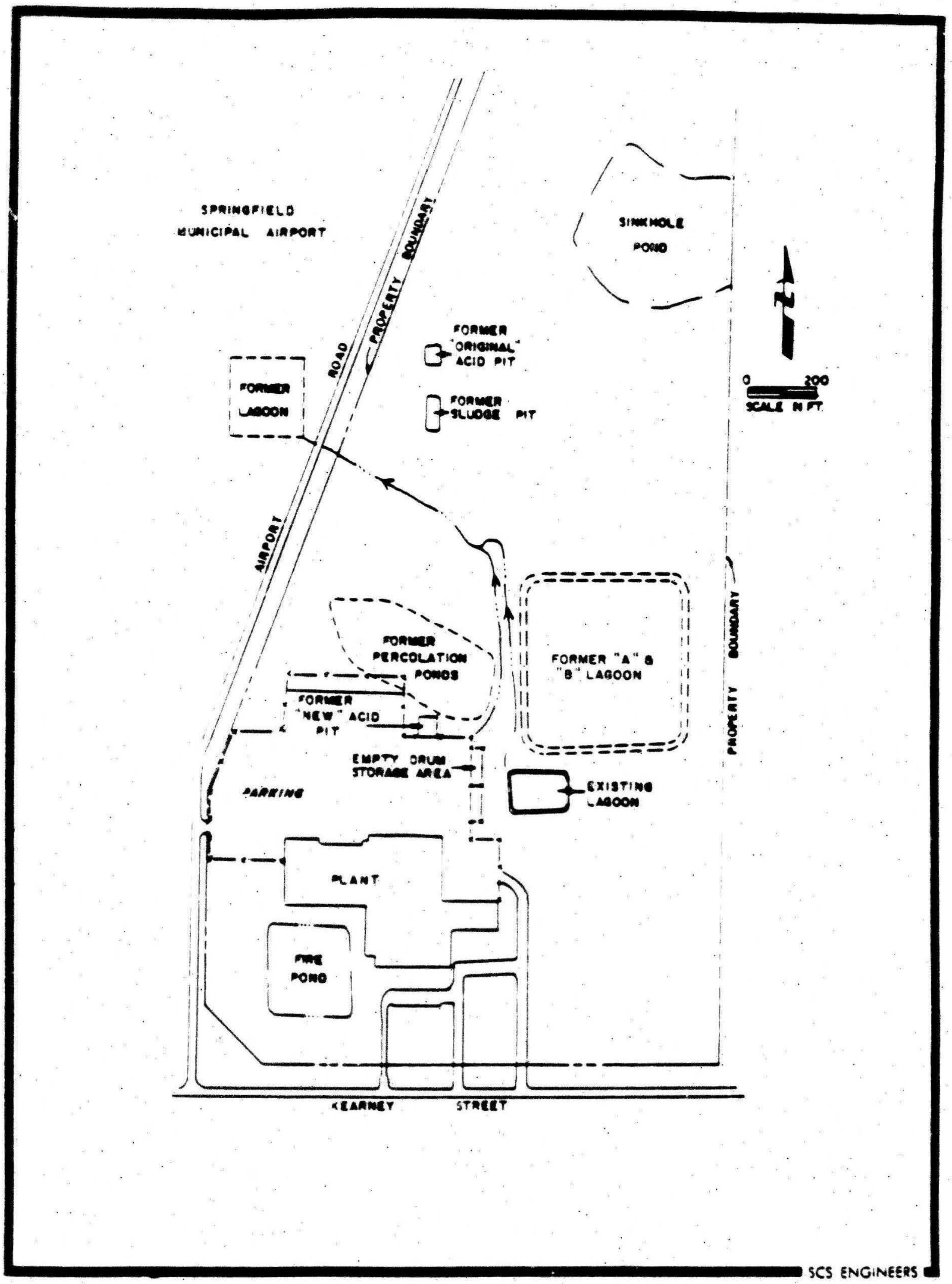

Figure 1. Site Map

was also sampled. Groundwater samples were analyzed and found to contain trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), methylene chloride, copper, and nickel. TCE was the only constituent detected in each of the seven wells; the other constituents identified do not appear to be as widespread. Two of the constituents (nickel and copper) are naturally-occurring metals. Based upon the preliminary investigation conducted, TCE was the principal contaminant of concern at the site.

Based upon the findings of the preliminary environmental assessment, a follow-up investigation was undertaken to characterize potential on-site and off-site sources, and the horizontal extent of shallow groundwater contamination. The investigation delineated the boundaries of several disposal pits, concluded that the ACD facility building does not appear to be a continuing source of TCE, and found that the highest TCE concentrations in shallow groundwater are present north of the building, where former on-site disposal areas were located. Further investigation is necessary to identify potential on-site and off-site sources of groundwater contamination. Appendix A contains tables and figures summarizing the data collected in this investigation.

TCE identified in groundwater at the ACD facility does not appear to be an immediate threat to human health, as groundwater in the immediate vicinity of the ACD facility does not appear to serve as a source of drinking water. There are no other known uses of groundwater in the immediate vicinity of the ACD facility.

Objectives and Approach

Based upon the findings of the recent investigation, the following three-phase plan of action has been formulated:

I. Implement immediate interim corrective measures to address the principal contaminant of concern (TCE) at the site. Based upon available data, the immediate interim groundwater corrective measures will be applied to the area of highest TCE concentrations.

II. Monitor the regional aquifer by installing wells into the aquifer beneath the site.

III. Complete site characterization and perform engineering analyses to identify long-term corrective measures.

Each of these actions is described below.

I. IMPLEMENT INTERIM CORRECTIVE MEASURES

To implement immediate corrective measures at the ACD facility, a preliminary groundwater extraction and treatment system for contaminated shallow groundwater will be installed. Three 6-inch diameter extraction wells will be completed to the top of the limestone underlying the site; the wells will be perforated from the top of the groundwater table to the bottom of these wells.

Proposed well locations are shown on Figure 2. These wells will be placed to remove groundwater exhibiting the highest concentrations of TCE.

The actual yield of these wells will not be known until they are constructed and pumped. However, based upon the clayey soils present at the site, we assume for planning purposes that each of the wells will yield between 10 and 15 gallons per minute. The actual concentration of TCE in groundwater from these wells also will not be known until the wells are constructed and sampled. However, based upon the known distribution of TCE at the site, we assume an average TCE value of 30 mg/l for the three wells.

Once the wells have been constructed, slug tests will be performed to evaluate the hydraulic conductivity of the soils at the site. This information will then be used to estimate the radius of influence of each well.

Extracted groundwater will be treated by air stripping; an air stripping system will be installed at the facility. The air stripping system is anticipated to consist of two towers in series, each approximately 20 feet in height. The system will be overdesigned so that additional volume can be treated in the future. The system will be located at a convenient location in the rear of the ACD facility. The City of Springfield Public Works Department will be contacted and a request made to temporarily amend the existing wastewater contribution permit tc allow an increase to the existing allowable volume of 300,000 gallons per day. Treated groundwater will then be disposed of into the existing sanitary sewer system. Concurrently, an application for an NPDES permit will be prepared and submitted. Once this permit is issued,

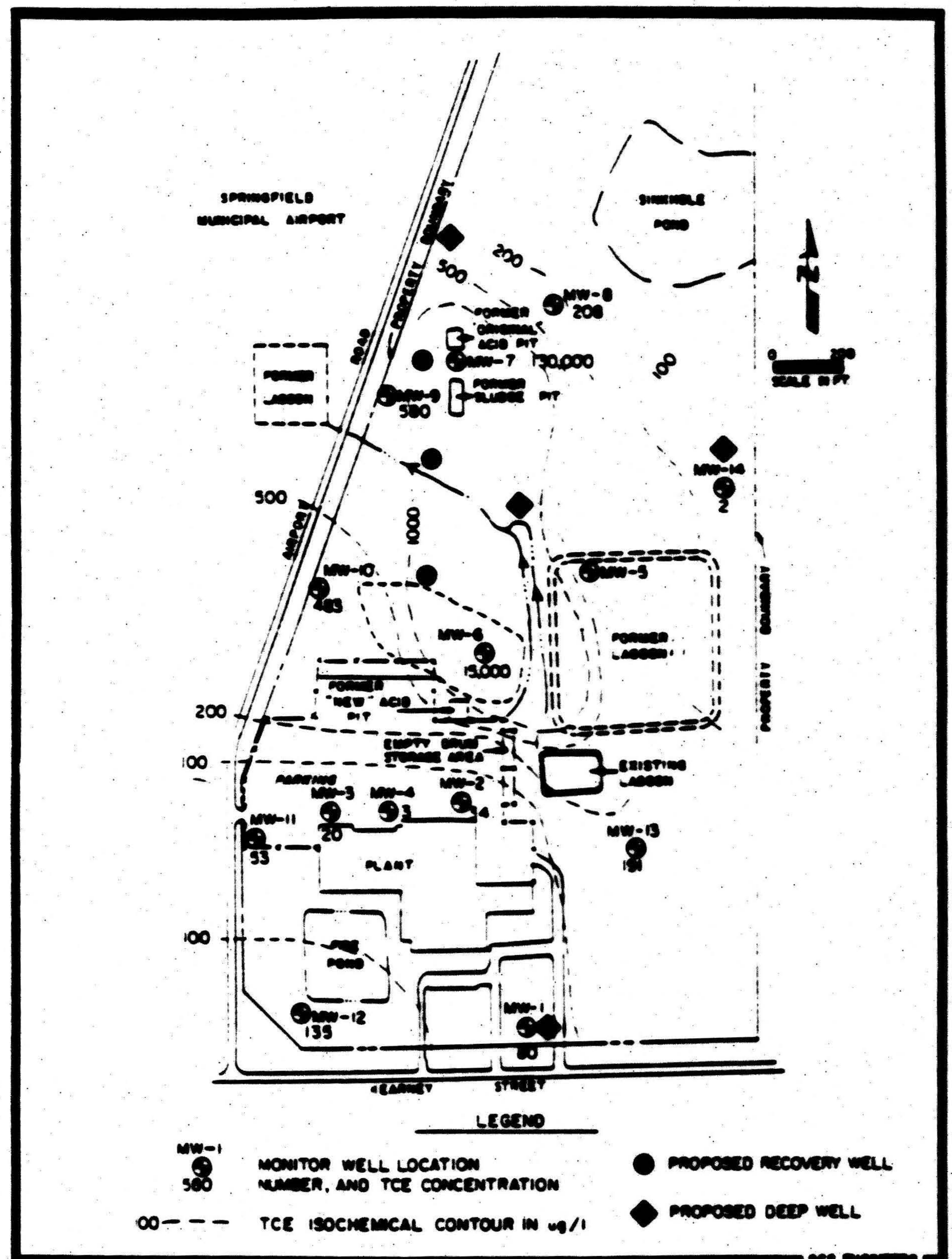

Figure 2. Proposed Recovery and Deep Monitoring Well Locations

disposal into the sewer system will cease. An air quality permit will be obtained, if necessary, and the existing wastewater contribution permit for the ACD facility modified. The existing sewer system at the facility should have sufficient capacity to accept the treated groundwater.

II. MONITOR DEEPER AQUIFER

Task I - Prepare Monitoring Well Plans and Specifications

To monitor groundwater quality in the upper limestone aquifer, plans and specifications for four wells approximately 100 feet in depth will be prepared. The most efficient method of well construction would be to utilize an air rotary drilling rig to set surface casing 10 to 20 feet into the uppermost limestone, drill through the surface casing to the uppermost regional aquifer, and then use the open borehole as the well. This method of well construction was suggested by Mr. James Van Dyke of the MDNR Division of Geology and Land Survey. A schematic of this method of well construction is presented in Figure 3.

After the surface casing is installed in the initial borehole, the annulus between the casing and borehole wall will be filled with cement grout utilizing the circulation and displacement method. With this method, a pre-measured amount of cement grout is pumped down the inside of the casing. Once the cement is pumped, it is followed by a calculated volume of water which will displace the slurry inside the casing, forcing the cement grout

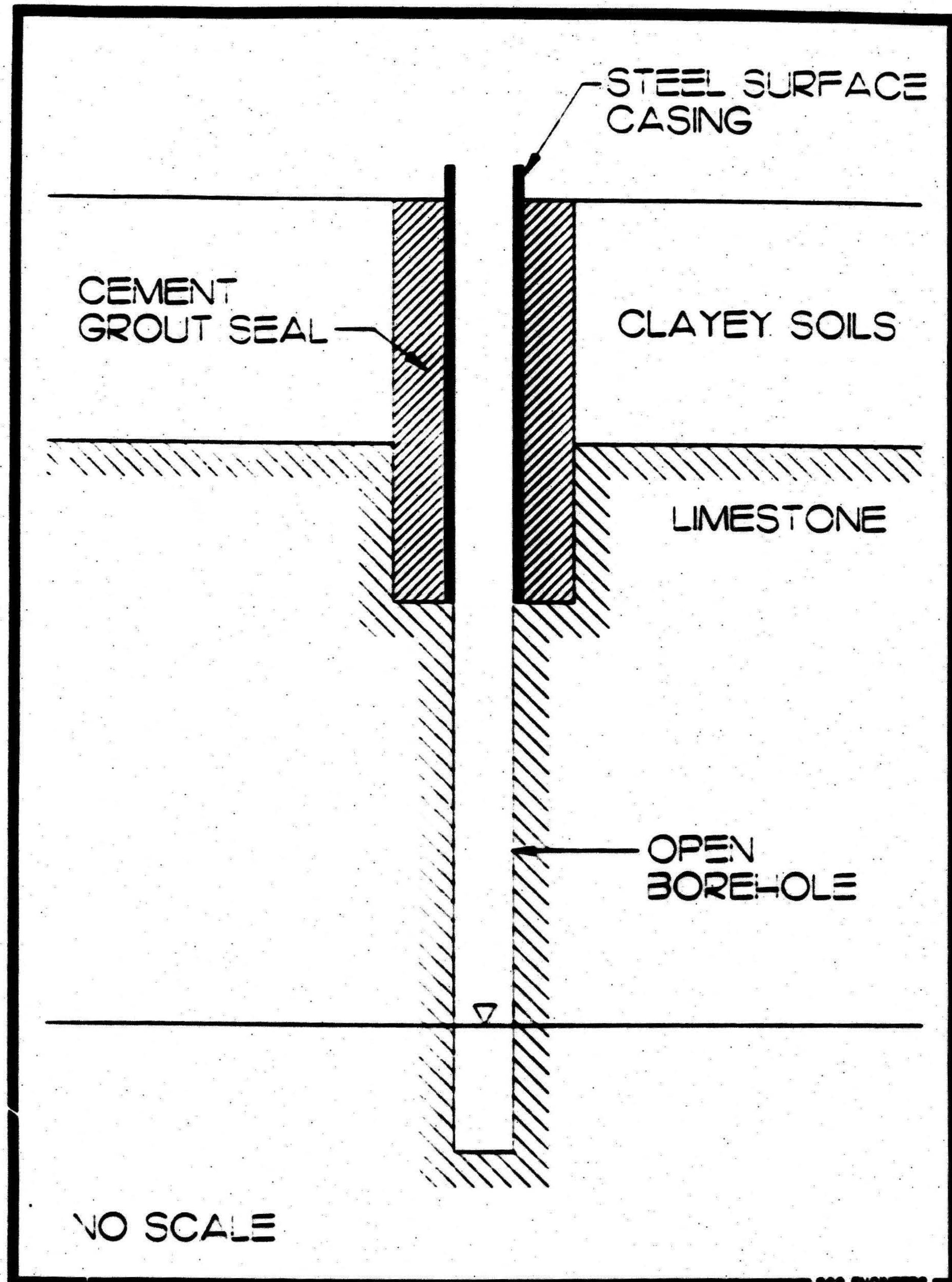

Figure 3. Schematic of proposed deep well construction.

into the annulus and sealing the well. MDNR Division of Environmental Quality approval for this method of construction will be requested.

The plans and specifications will then be released to selected drilling firms and bids solicited. SCS will assist Litton in the selection of a drilling contractor.

Task II - Drilling and Well Construction

The proposed locations of the four deep monitoring wells are shown in Figure 2. The wells will be drilled deep enough to penetrate approximately 20 feet into the regional aquifer. A health and safety plan previously prepared for the site will be utilized. The wells will be completed with locking steel protective covers, and wellhead elevations surveyed. Drill cuttings will be left on site.

Task III - Well Development, Sampling, and Laboratory Analyses

Static water levels will first be measured. The wells will then be developed by overpumping with a portable submersible pump. Pumped groundwater will be stored on site pending the results of laboratory analyses. Field parameters (pH and specific conductance) will be measured and recorded during development; at the completion of development, a groundwater sample will be collected for laboratory analysis. Groundwater samples will be analyzed for purgeable halocarbon compounds in accordance with EPA Method 601, and for total and dissolved concentrations of cyanide, nickel, zinc, and copper.

Task IV - Draft and Final Report

Upon receipt of laboratory results, a written report will be prepared. The report will contain the findings of the above tasks, conclusions, and recommendations.

III. IDENTIFICATION OF CORRECTIVE MEASURES

Selection of corrective measures will consider the following:

Risk Assessment

Upon completion of data collection activities, a risk assessment will be performed to address any significant contamination detected. The purpose will be to provide an evaluation of the potential threat to human health and the environment. The risk assessment will include the following four components:

- Contaminant identification.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.

Identification of Soil Remediation Alternatives

Former disposal activities at selected locations at the ACD facility have resulted in the presence of certain metals (lead, chromium, and copper) at concentrations exceeding Missouri Department of Health (MDOH) safe levels. Accordingly, these locations will be further characterized to delineate the extent of soils requiring remediation.

Soil remediation alternatives will then be evaluated. Excavation of soils exceeding MDOH safe levels probably will be required. These soils may be either treated on site, or disposed of off site.

Identification of Groundwater Removal and Treatment Measures

Based upon the findings of the previous tasks, measures to control contaminant migration will be identified. Data generated during implementation of interim measures will be particularly useful, since it will provide actual data regarding pumping rates and treatment efficiency for the shallow aquifer. Additional steps necessary to control and recover contaminated groundwater will be identifiea; these may require alteration of the hydrologic system beneath the site to recover contaminated groundwater for treatment and to prevent the migration of this groundwater off site.

Computer modeling may be performed to create potential scenarios for controlling contaminant migration. However, the actual data generated during implementation of interim measures will probably be more useful than computer modeling.

In conjunction with recovery of contaminated groundwater, additional groundwater treatment capacity (over and above that provided as part of interim measures) may be necessary. Contaminant concentrations will be assessed, and appropriate treatment alternatives evaluated. Treatment alternatives include air stripping, carbon filtration, and ion exchange. These alternatives may be used alone or in combination depending on the contaminants detected and their concentrations.

The various groundwater recovery and treatment alternatives identified will be evaluated for their effectiveness and efficiency. Based upon this evaluation, an alternative will be recommended. Additional investigation may be necessary to collect specific design information for the recommended alternative. The evaluation and recommendation will be presented in a written report.

Implementation

A bid package containing plans and specifications will be prepared, contractors selected, and construction of a remedial system performed. System start-up, and periodic monitoring, will be conducted to confirm the system is recovering and treating contaminated groundwater as intended.

SCHEDULE

If acceptable to MDNR, implementation of interim corrective measures can begin immediately. Procurement of the necessary system components and services is estimated to require four months. Concurrent with this effort, the proposed wells and sampling of the deeper aquifer will be accomplished. Completion of the risk assessment and system evaluation tasks will require three months following completion of the deeper aquifer monitoring task.

APPENDIX A

FIGURES AND TABLES

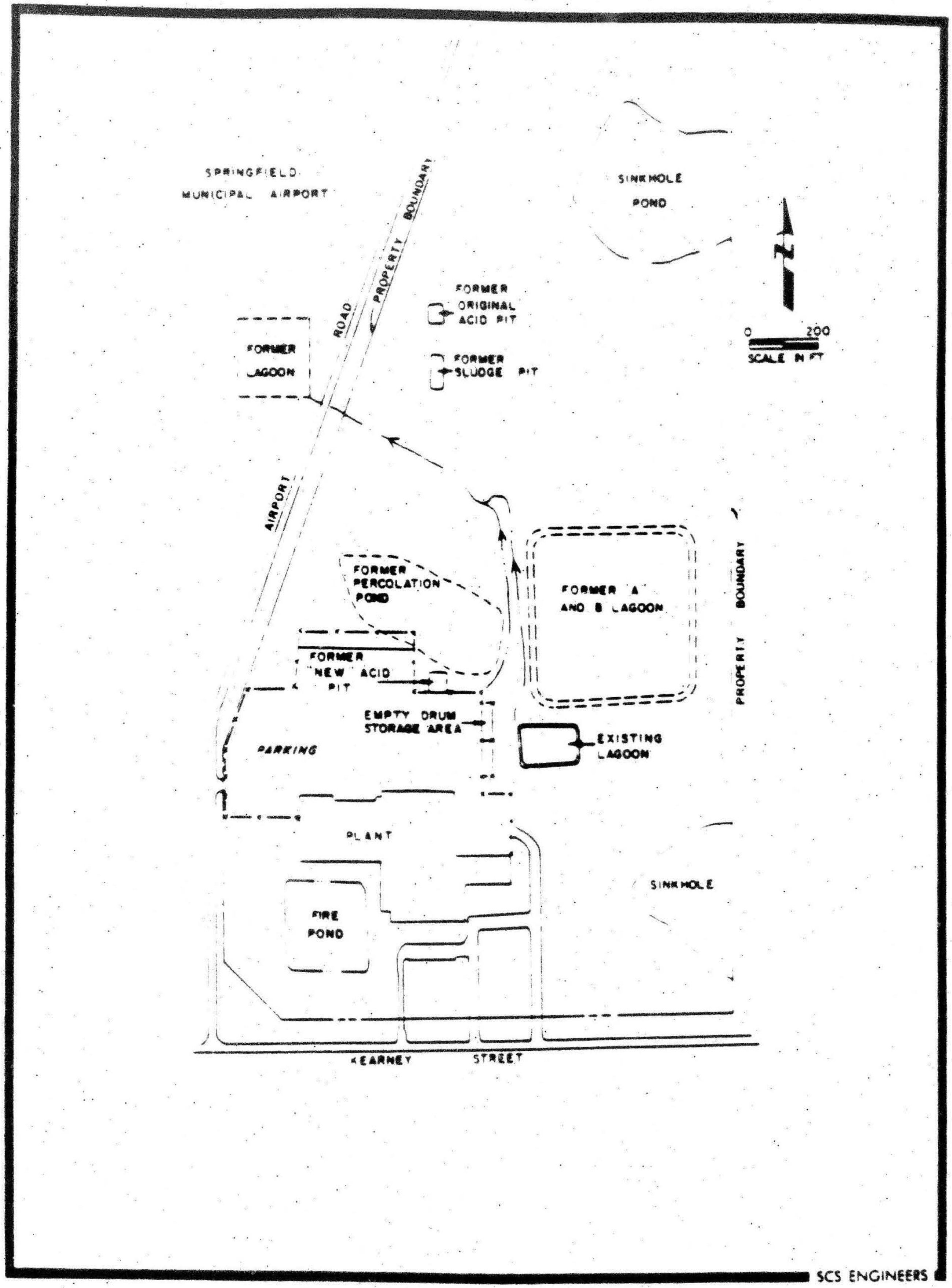

Figure A-1. Site Map

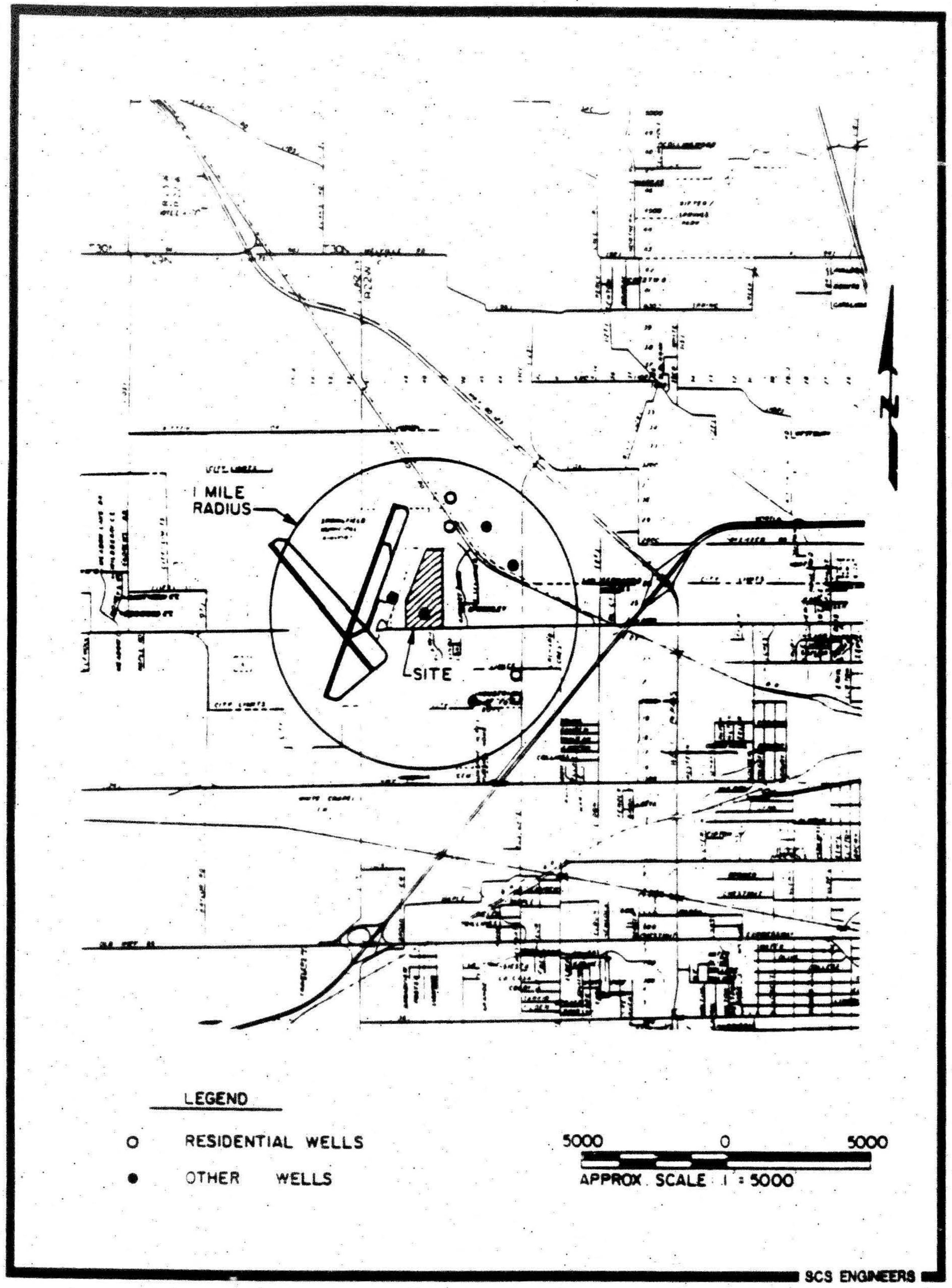

Figure A-2. Identified Well Locations Within One Mile of the ACD Facility

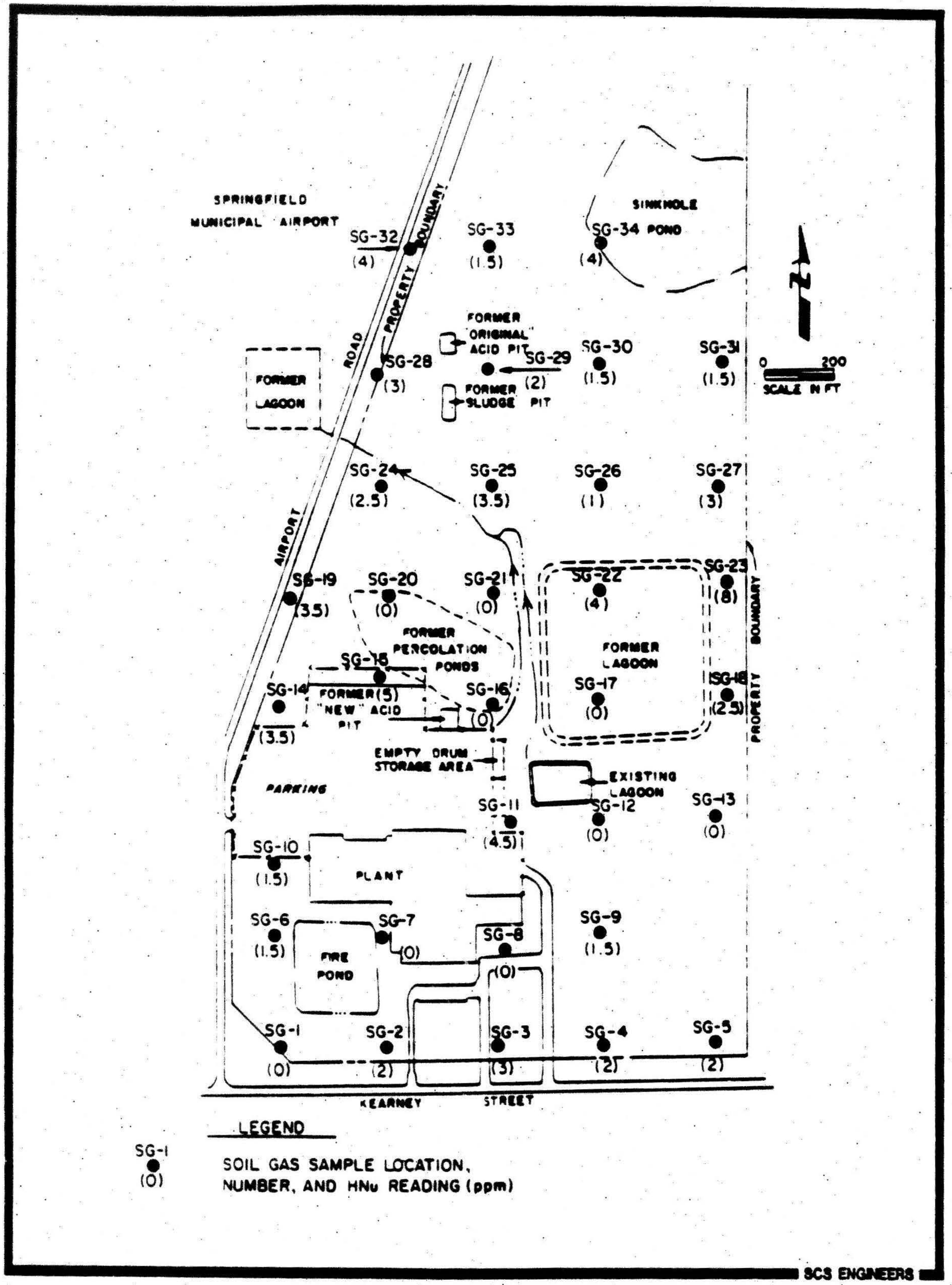

Figure A-3. Soil Gas Sampling Locations.

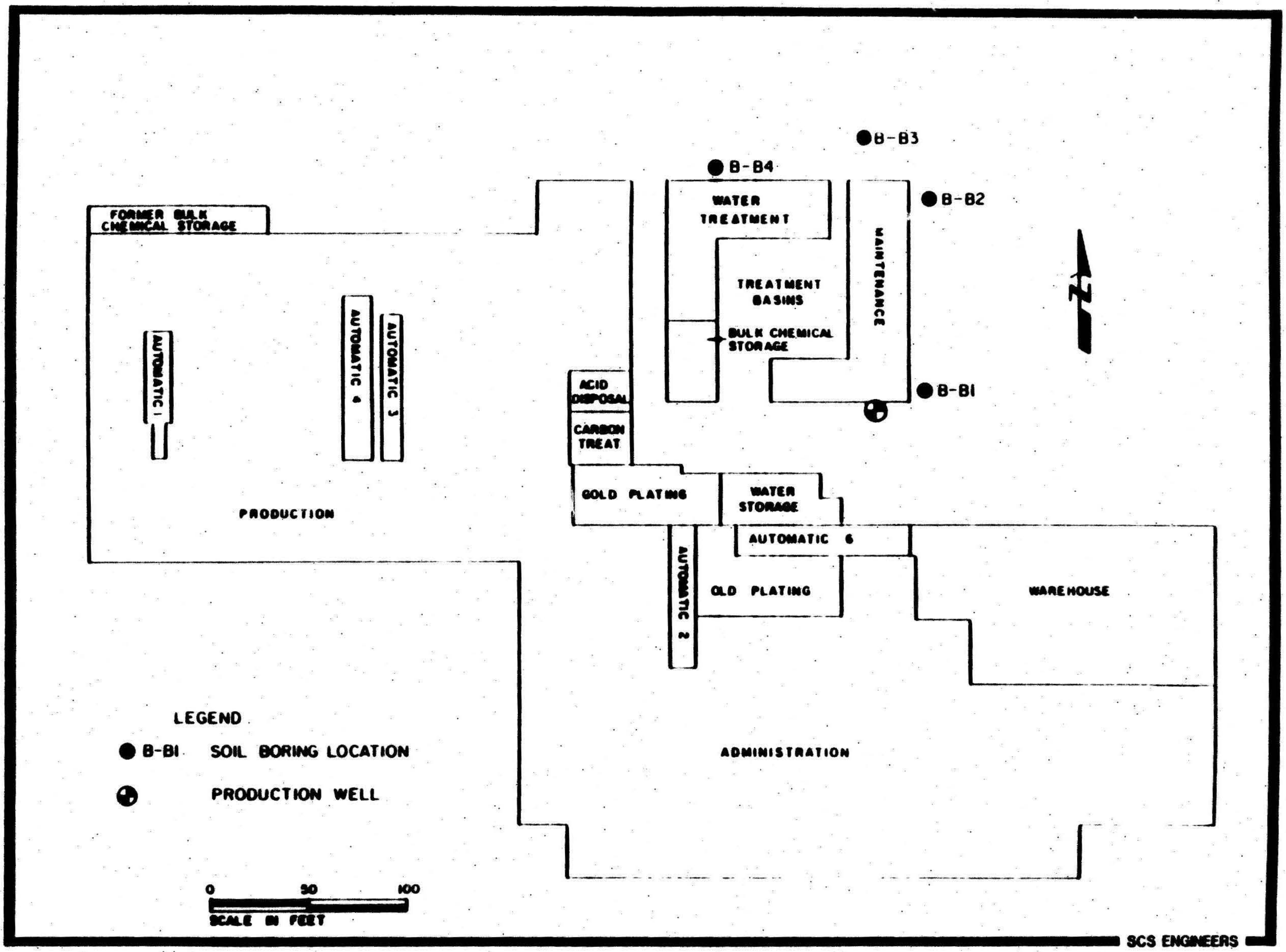

Figure A-4. Soil Boring Locations Adjacent to the Wastewater Treatment Plant.

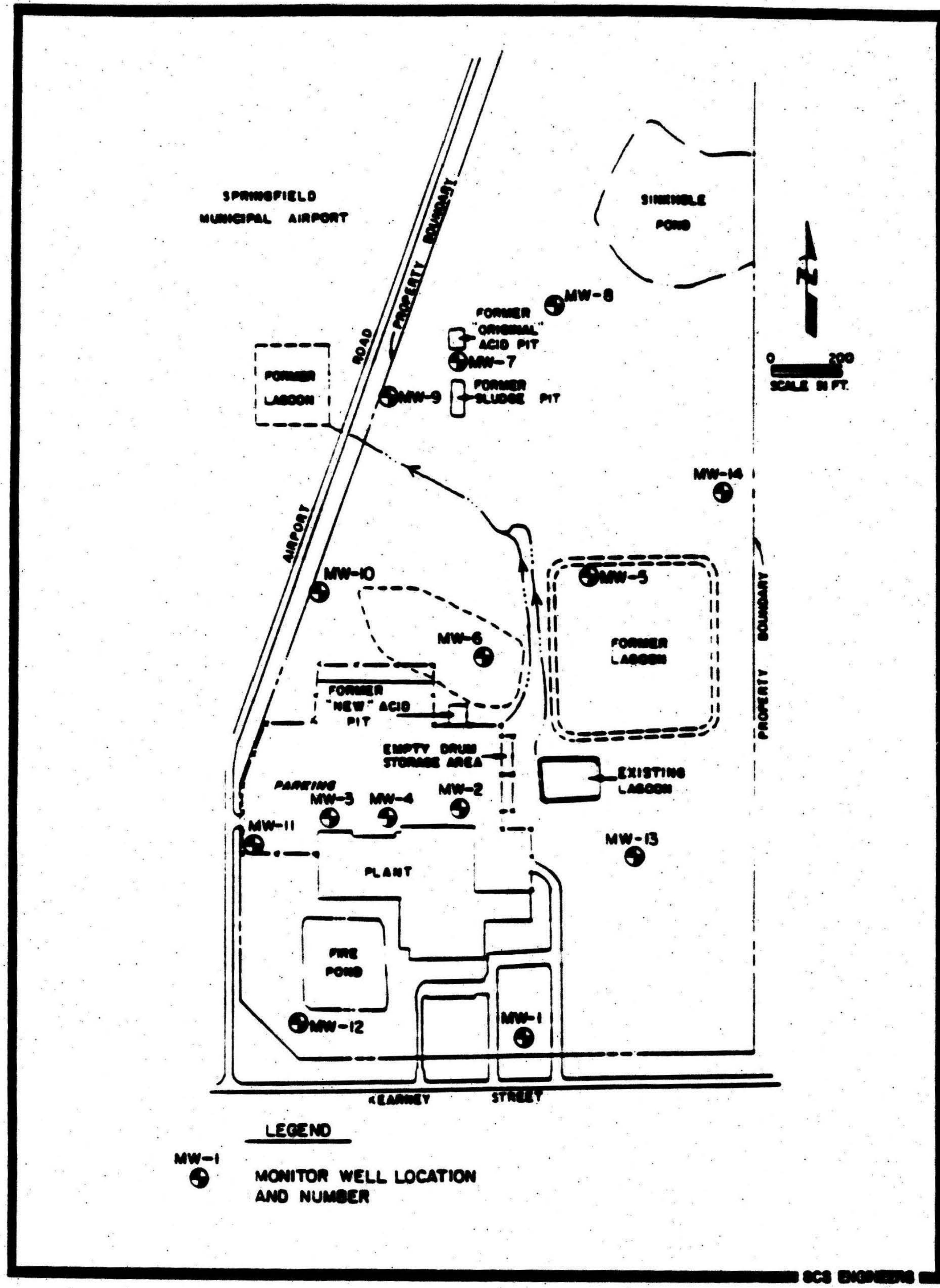

Figure A-5. Monitor Well Locations.

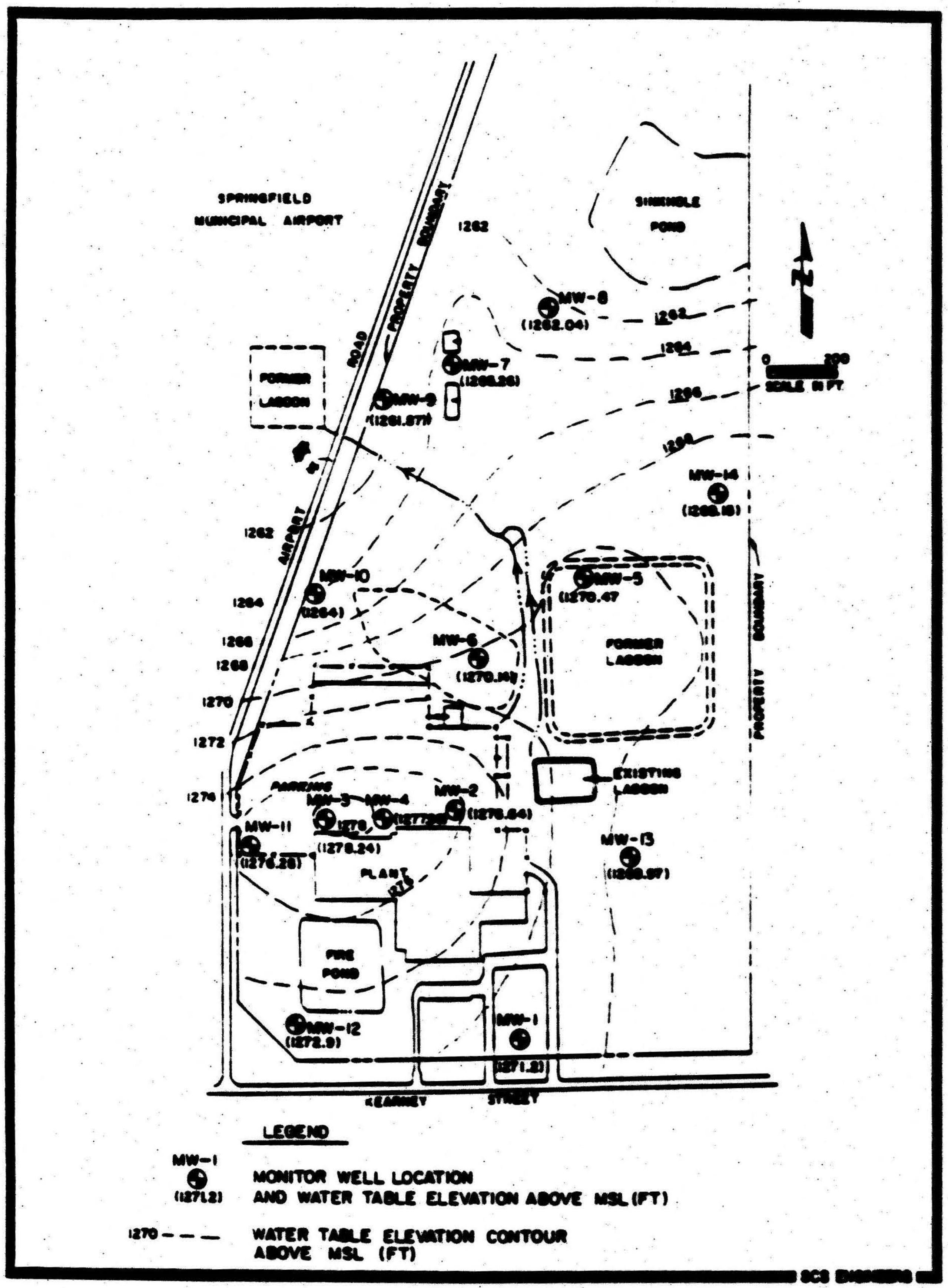

Figure A-6. Water Table Contour Map (January 1991 Water Levels).

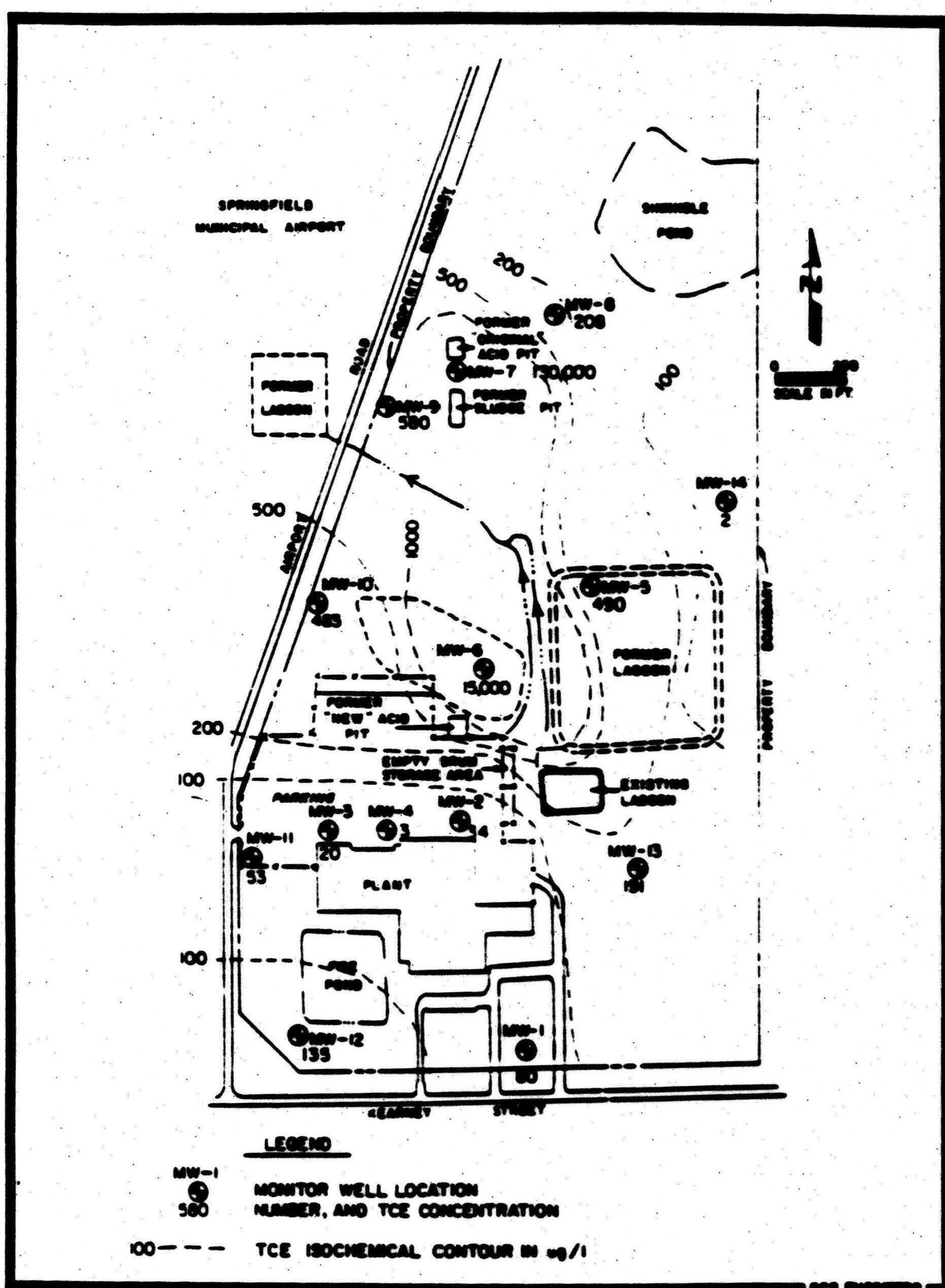

Figure A-7. TCE Isochemical Contour Map.

TABLE A-1. WELLHEAD ELEVATIONS, MEASURED DEPTH TO WATER, AND WATER TABLE ELEVATIONS (JANUARY 24-26, 1991)

Well	Top of PVC Casing Elevation (Ft above MSL)*	Depth to Water (Feet)	Water Table Elevation (Feet above MSL)
MW-1	1285.89	14.69	1271.20
MW-2	1282.50	5.86	1276.64
MW-3	1281.95	3.71	1278.24
MW-4	1282.33	4.38	1277.95
MW-5	1277.61	7.14	1270.47
MW-6	1274.44	4.30	1270.14
MW-7	1273.38	7.12	1266.26
MW-8	1268.06	6.02	1262.04
MW-9	1265.91	4.04	1261.87
MW-10	1271.52	7.52	1264.00
MW-11	1279.28	3.00	1276.28
MW-12	1277.22	4.32	1272.90
MW-13	1280.09	11.12	1268.97
MW-14	1272.90	3.75	1269.15

* Reference NGVD 1929, VSGS Benchmark #88, Springfield Benchmark System, located at Springfield Municipal Airport (Elevation 1275.10 Feet above MSL).

TABLE A-2. SUMMARY OF INORGANIC CONSTITUENTS IN SUBSURFACE SOILS (mg/kg)

Sample ID	Depth (Ft)	Cu	Ni	Zn	CN^-
B-B1-5.5	5.5	10	38	50	ND
B-B1-10	10	12	27	56	ND
B-B2-6	6	830	36	61	ND
B-B3-5	5	5	ND	20	ND
B-B3-10	10	6	12	29	ND
B-B3-15	15	9	11	39	ND
B-B4-5	5	47	13	24	ND
B-B4-7	7	9	ND	20	ND
B-B4-10	10	25	25	50	ND
Common Range in Natural Soils (EPA, 1983)		2-100	5-500	10-300	-
MDOH Safe Level		14,285	2,000	-	-

ND - Not detected (detection limit 10 mg/kg for Ni; 1 mg/kg for CN^-)

TABLE A-3. SUMMARY OF DETECTED ORGANIC COMPOUNDS IN SUBSURFACE SOILS (ug/kg)

Sample Number	Depth (ft.)	Ethanol	1,2-Dichloropropane	TCE
B-B1-5.5	5.5	ND	14	260
B-B1-10	10	ND	ND	130
B-B2-6	6	12	ND	41
B-B3-5	5	ND	ND	ND
B-B3-10	10	11	16	73
B-B3-15	15	13	21	200
B-B4-5	5	ND	ND	ND
B-B4-10	10	480	ND	ND

ND = Not Detected (detection limits shown in Appendix E)

TABLE A-4. AVAILABLE MDOH SAFE LEVELS FOR VOLATILE ORGANIC COMPOUNDS AT THE ACD FACILITY

	Recommended Safe Soil Level (mg/kg)	Recommended Safe Water Level (ug/l)
Methylene Chloride	None	1.9
1,1,1- TCA	9000	200
TCE	71	5

TABLE A-5. SUMMARY OF INORGANIC CONSTITUENTS IN GROUNDWATER
(mg/l)

Sample ID	Cu	Ni	Zn	CN^-	Specific Conductivity (u ohms)	pH
MW-1	ND	ND	ND	ND	955	NA
MW-2	ND	ND	ND	ND	1,200	NA
MW-3	691	0.6	5.4	ND	14,200	4.84
MW-4	7.8	ND	ND	ND	1,300	6.41
MW-5	0.2	0.5	ND	ND	7,600	7.08
MW-6	0.4	0.5	0.1	ND	5,400	6.64
MW-7	5.4	0.8	0.1	ND	3,800	NA
MW-8	ND	ND	ND	ND	860	6.90
MW-9	ND	ND	ND	ND	350	7.03
MW-10	ND	ND	ND	0.3	1,175	6.71
MW-11	ND	ND	ND	ND	1,160	6.04
MW-12	ND	ND	ND	ND	800	7.03
MW-13	ND	ND	ND	ND	355	NA
MW-14	ND	ND	ND	ND	720	NA
Detection Limit	0.1	0.5	0.1	0.2	--	--
MDOH Safe Level	1.0	0.2	None	None	--	--
MO GW Quality Standard	C.02	0.1	0.1	0.005	--	--

ND - Not Detected
NA - Not Analyzed

TABLE A-6. SUMMARY OF DETECTED VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER (ug/kg)

Well Number	1,2-Dichloropropane	1,1,1-TCA	TCE	Chloroform	1,1-DCA	1,2-DCA	Trans-1,2-DCE	Bromo-dichloromethane	Methylene Chloride	1,1-DCE	1,1,2-TCA	PCE	Carbon Tetra-chloride
MW- 1	23	ND	80	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW- 2	22	ND	34	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW- 3	15	20	20	ND	ND	ND	70	ND	5,000	ND	ND	ND	ND
MW- 4	9	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW- 5	135	400	490	ND	60	ND	ND	ND	ND	134	ND	ND	ND
MW- 6	1,500	12,000	15,000	8	32	ND	15	ND	90	1,200	43	10	ND
MW- 7	ND	1,000	130,000	ND	910	480	ND	30	73,000	29,300	ND	2,500	100
MW- 8	ND	76	208	ND	ND	ND	ND	ND	ND	ND	ND	5	ND
MW- 9	ND	197	580	ND	12	ND	ND	ND	ND	250	ND	7	ND
MW-10	172	53	483	ND	ND	ND	ND	ND	ND	ND	ND	18	ND
MW-11	40	14	53	ND	28	ND	ND	ND	ND	10	ND	ND	ND
MW-12	50	ND	135	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-13	50	17	191	ND	17	ND	ND	ND	ND	ND	ND	ND	ND
MW-14	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Contaminant Level	5*	200	5	100**	-	5	100*	100**	-	7	-	5*	5

ND = Not Detected (detection limits shown in Appendix E) * Effective July 1992 ** Total for Trihalomethanes